REMARKS

Claims 1-31 and 33-38 are pending in the present application. Claims 1 and 28 have now been amended. Claim 32 was previously cancelled.

Support for the amendment to claim 1 can be found, for example, in paragraphs [0042], [0045], [0047], [0049] and [0056] of the application published as US 2006/0162500 A1. Support for the amendment to claim 28 can be found, for example, in paragraphs [0008], [0011] and [0056] of the published application. No new matter has been added.

Claims 1-30, 33-34 and 36-38 were rejected under 35 U.S.C. §103(a) as being unpatentable over Formanek (Australian Patent No. 9894057 A) in view of Hiltunen (U.S. Patent No. 5,505,907) and any one of Beisswenger (U.S. Patent No. 4,817,563), Reh (U.S. Patent No. 4,080,437) or Schmidt (U.S. Patent No. 4,402,754).

Claim 31 was rejected under U.S. C. §103(a) as being unpatentable over Formanek in view of Hiltunen and any one of Beisswenger, Reh or Schmidt as applied to claims 1, 2-30, 32-34 and 36-38 above, in further view of Lapple (U.S. Patent No. 3,578,798).

Claim 35 was rejected under 35 U.S.C. §103(a) as being unpatentable over Formanek in view of Hiltunen and any one of Beisswenger, Reh or Schmidt as applied to claims 1, 2-30, 32-34 and 36-38 above, in further view of Engstrom (WO Patent No. 90/11824).

Claims 1-5 were provisionally rejected on the ground of nonstatutory obviousness type double patenting as being unpatentable over claims 1-5 of pre-grant publication US 2006-0230880 (U.S. 10/540,434), pre-grant publication US 2007-0137435 (U.S. 10/540,435) and pre-grant publication US 2006-0231466 (U.S. 10/540,436), respectively.

<u>Nonstatutory Non-Obviousness Double Patenting Rejections</u>

Claims 1-5 were provisionally rejected on the ground of nonstatutory obviousness type double patenting as being unpatentable over claims 1-5 of pre-grant publication US 2006-0230880 (U.S. 10/540,434), pre-grant publication US 2007-0137435 (U.S. 10/540,435) and pre-grant publication US 2006-0231466 (U.S. 10/540,436), respectively.

A terminal disclaimer under 37 C.F.R. 1.321 will be filed with this Response to overcome the provisional nonstatutory obviousness type double patenting rejections. It is respectfully

submitted that the provisional nonstatutory obviousness-type double patenting rejections will be moot in view of said filing. The withdrawal of the provisional rejection is immediately proper and therefore respectfully submitted.

Withdrawal of the rejections is therefore respectfully requested.

<u>Rejections of Claims 1-30, 33-34 and 36-38 under 35 U.S.C. § 103(a)</u>

Claims 1-30, 33-34 and 36-38 were rejected under 35 U.S.C. §103(a) as being unpatentable over Formanek in view of Hiltunen and any one of Beisswenger, Reh or Schmidt.

Formanek describes a method for reducing ilmenite, i.e., iron titanium oxide ($FeTiO_3$). Formanek thereby uses two reactors. The ilmenite is partly reduced to a degree of metallization of 50 % to 90 % in a first fluidized-bed reactor and is reduced to a degree of metallization of 85 % to 98 % in a second reactor which contains at least one stationery fluidized bed. See Formanek, page 1, third paragraph, line 3 to page 2, first paragraph, line 1. The crude, preheated granular ilmenite is thereby supplied through a passage (17) to the first fluidized-bed reactor from which treated ilmenite is continually removed to the second fluidized bed reactor via line 33 . Cooled, reduced ilmenite is subsequently withdrawn from the second reactor via line 38. See Formanek, page 4, second paragraph, lines 1-4, page 5, third paragraph, lines 1-5 and page 6, second paragraph, lines 1-2.

Hiltunen describes a method and apparatus for cooling hot gas in a reactor. Hiltunen thereby describes a reactor (10) where the lower section is provided with a hot gas inlet (16) and a chamber encompassing a fluidized bed (14), the middle section is provided with a riser (22), and the upper section with a gas outlet (30), whereby the reactor has heat transfer surfaces (46 and 44) for recovering heat from solid particles and two conduits (54 and 56) to regulate the volume of the particles. See Hiltunen, column 1, lines 7-13. The reactor (10) in Hiltunen is annular and the riser (22) is defined by cooling panels or walls (24). See Hiltunen, column 3, line 66 to column 4, line 12 and column 5, lines 2-4.

Beisswenger describes a fluidized bed system for carrying out exothermic processes in a circulating fluidized bed. See Beisswenger, column 1, lines 5-7.

Reh describes a process for the thermal decomposition of aluminum chloride hexahydrate in a highly expanded state of fluidization using a fluidizing residence reactor. The central part of the Reh apparatus for carrying out the process consists of a turbulent reactor were a specific suspension density is achieved and a residence reactor. See Reh, column 1, lines 5-7 and column 2, lines 21-34.

Schmidt describes a process of producing cement clinker comprising preheating the raw cement powder in a suspension-type heat exchanger, de-acidifying in a precalcining system, clinkering in a fluidized bed, and subsequently cooling the clinker. The de-acidification is effected in a circulation system comprising a fluidized bed reactor, a cyclone separator and a recycling duct. See Schmidt, column 1, lines 6-10 and column 1, line 67 to column 2, line 2.

Independent claim 1 of the present application has now been amended so as to recite a method for the heat treatment of solids containing titanium including "introducing the solids into the reactor" of a "stationary annular fluidized bed" reactor "and removing the treated solids from the reactor."

It is respectfully submitted that incorporating the reactor design of Hiltunen into the titanium ore (ilmenite) reduction process of Formanek would not provide removing a treated solid from the stationary annular fluidized bed reactor as recited in claim 1. The reactor of Hiltunen is used to cool gas by repeatedly heating and cooling the same solid material. See Hiltunen, the abstract, column 1, lines 7-8 and column, 3, lines 5-11. In Hiltunen, no treated solid material is removed from the reactor; the solid material in Hiltunen is merely recirculated. See, Hiltunen, column 2, lines 31 to 42, column 3, lines 36 to 47 and column 4, lines 39 to 61. Hiltunen contains two conduits (54 and 56) merely for volume regulation. See Hiltunen, column 5, lines 2-4. The combination of Formanek with Hiltunen would therefore at best yield a system where ilmenite is used as a solid material to cool gas, however, no treated product would be produced except for cooled exhaust gas.

Independent claim 1 of the present application as amended also recites "adjusting the gas velocities of the first gas or gas mixture as well as of the fluidizing gas for the annular fluidized bed such that the particle Froude numbers in the gas supply tube are between 1 and 100, in the annular fluidized bed between 0.02 and 2 and in the mixing chamber between 0.3 and 30".

It is respectfully submitted that one of ordinary skill in the art would not have incorporated the particle Froude number control means of Beisswenger, Reh or Schmidt into the titanium ore

(ilmenite) reduction process of Formanek incorporating the Hiltunen reactor. Beisswenger, Reh and Schmidt only describe broad general Froude ranges because each of said references lack the feature of an annular fluidized bed required in the present application. Beisswenger, Reh and Schmidt each involve a circulating fluidized bed and therefore cannot teach or suggest the specific Froude ranges of the stationary annular fluidized bed or of the gas supply tube of independent claim 1.

The purpose of the Hiltunen reactor to cool a hot gas stream. To facilitate cooling, Hiltunen therefore provides the heat exchangers 44 and 46 inside the return duct (36) and in the fluidized bed (14) in addition to the cooled walls (24) of the riser (22). The particles flowing back to the fluidized bed thereby release heat to the cooled walls (24) of the riser (22). This local cooling of the suspension in the riser (22) leads to increased local densities and decreased volume flow. The particles close to the wall therefore sink down as is indicated in Hiltunen by the arrows in Figs. 1-3; i.e., the downward arrow next to wall 24. The flow characteristics in the Hiltunen reactor are therefore achieved through flow directions caused by the temperature profile of the reactor. Said flow directions can only be realised if relatively high temperature gradients exist in the reactor. Such a high temperature gradient does not exist for the present invention. The inhomogeneous flow conditions in the Hiltunen reactor also allow no possibility for determining any characteristic Froude number. The process conditions in the Hiltunen reactor cannot be characterized by a certain particle Froude numbers.

It is respectfully submitted that one of ordinary skill in the art would furthermore not have combined Formanek with Hiltunen to begin with. The object underlying Formanek is to reduce ilmenite in a manner suitable for commercial plants and to operate as inexpensively as possible. See, for example, page 1, third paragraph, lines 1-3. The object of Hiltunen is to cool a hot gas before said gas touched heat transfer surfaces in order to avoid the fouling and clogging of said heat transfer surfaces. See, for example, column 2, lines 8-14. Fouling and clogging is not a problem that was sought to be solved in the Formanek process. One of ordinary skill in the art seeking to produce reduced ilmenite would furthermore not have considered the Hiltunen reactor for at least two additional reasons. Firstly, the reduction of ilmenite does not require a hot gas to be cooled in a reactor. Secondly, the production of reduced ilmenite in Formanek requires the continual addition of crude ilmenite coupled with the continual withdrawal of treated and reduced ilmenite. Hiltunen

teaches away from such a continual addition and withdrawal by limiting conduits 54 and 56 to volume regulation.

Therefore, it is respectfully submitted that a person of ordinary skill in the art would not have combined Hiltunen with Formanek, Beisswenger, Reh or Schmidt. Moreover, as discussed above, such a combination would not in any event teach or suggest all the limitations of claim 1. A combination of Formanek with Hiltunen and Beisswenger, Reh or Schmidt, to the extent combined, could not, therefore, render independent claim 1 or any of the dependent claims obvious.

With respect to independent Claim 28, that claim has now been amended so as to recite a plant for the heat treatment of solids containing titanium including a "stationary annular fluidized bed" reactor with "a solids separator downstream of the reactor, wherein the solids separator comprises a solids conduit leading to the annular fluidized bed of the reactor and a solids conduit leading to a stationary fluidized bed of a second reactor provided downstream of the reactor."

As stated with respect to independent claim 1 above, a combination of Formanek with Hiltunen would not teach or suggest the limitations of independent claim 28 because Hiltunen teaches a reactor which cools gas by repeatedly heating up and then cooling down the same solid material via recirculation within the reactor. Hiltunen thereby teaches that no solid materials ever exit the reactor. It is respectfully submitted that a person of ordinary skill in the art would not have provided the reactor of Hiltunen with a downstream separator, as recited in claim 28. Hiltunen has no need for a downstream separator because no solid material ever leaves the Hiltunen reactor as a product. As noted above, the combination of Formanek with Hiltunen would at best yield a system where ilmenite is used as a solid material to cool gas, however, no product would be produced except for cooled exhaust gas.

Independent claim 28 provides that "the solids separator comprises a solids conduit leading to the annular fluidized bed of the reactor and a solids conduit leading to a stationary fluidized bed of a second reactor provided downstream of the reactor." By providing two solids conduits downstream of the separator, it is possible to flexibly adjust the portion of solids returned to the reactor and to thereby flexibly adjust the bed height of the solids in the annular fluidized bed of the reactor. The adjustment of the bed height of the solids in the annular fluidized bed of the reactor allows for adjustable solids retention times and a high degree of pre-reduction of the iron in the

ilmenite to be achieved while virtually preventing the formation of complex M_3O_5 phases. See, for example, paragraph [0013] of the published application. No such adjustment of the bed height of an annular fluidized bed reactor using a solids separator can occur in Formanek because no annular fluidized bed exists. No such adjustment of the bed height of an annular fluidized bed reactor using a solids separator can occur in Hiltunen because no solids leave the reactor. Hiltunen also teaches away from providing and feeding a second reactor with particles discharged from its reactor since all solids stay within the first reactor. A person of ordinary skill in the art would therefore not provide a combination of Formanek and Hiltunen with a solids separator including a solids conduit leading to the annular fluidized bed of the reactor and a solids conduit leading to a stationary fluidized bed of a second reactor provided downstream of the reactor as required by independent claim 28.

It is respectfully submitted, therefore, that the combination of Formanek with Hiltunen, to the extent proper, would not render independent claim 28 or any of its dependent claims obvious.

Withdrawal of the rejection to claims 1-30, 33-34 and 36-38 under 35 U.S.C: § 103(a) is therefore respectfully requested.

Rejection of Dependent Claim 31 under 35 U.S.C. § 103(a)

Claim 31 has been rejected under U.S. C. §103(a) as being unpatentable over Formanek in view of Hiltunen and any one of Beisswenger, Reh or Schmidt as applied to claims 1, 2-30, 32-34 and 36-38, and further view of Lapple.

Lapple describes the construction and arrangement of fluidized beds and particularly to improvements in the construction and improvement of a fluidized bed apparatus. The fluidized bed unit in Lapple can be a high capacity fluidized bed unit formed of single or multiple stages where reaction products may be maintained out of contact with gaseous products of combustion used to provide heat for the reaction. See Lapple, the abstract and column 1, lines 3-5.

Claim 31 depends on independent claim 28. As stated above, a combination of Formanek with Hiltunen and any one of Beisswenger, Reh or Schmidt would not teach or suggest all the limitations of claim 28. Lapple does not cure said defect. A combination of Formanek and

Hiltunen and any one of Beisswenger, Reh or Schmidt, even in view of Lapple, could not, therefore, render claim 31 obvious.

Withdrawal of the rejection to claim 31 under 35 U.S.C: § 103(a) is therefore respectfully requested.

Rejection of Dependant Claim 35 under 35 U.S.C. § 103(a)

Claim 35 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Formanek in view of Hiltunen and any one of Beisswenger, Reh or Schmidt as applied to claims 1, 2-30, 32-34 and 36-38, and further view of Engstrom.

Engstrom describes a fluidized bed reactor comprising a reactor chamber provided with substantially vertical side walls laterally confining a bed of fluidizable particulate material and a gas distributor plate, through which primary gas is fed in to the reactor chamber. See Engstrom, page 1, lines 4-9.

Claim 35 depends on independent claim 28. As stated above, a combination of Formanek with Hiltunen and any one of Beisswenger, Reh or Schmidt would not teach or suggest all the limitations of claim 28. Engstrom does not cure said defect. A combination of Formanek and Hiltunen and any one of Beisswenger, Reh or Schmidt, even in view of Engstrom, could not, therefore, render claim 35 obvious.

Withdrawal of the rejection to claim 31 under 35 U.S.C: § 103(a) is therefore respectfully requested.

The Commissioner is hereby authorized to charge any unpaid fees deemed required in connection with this submission, including any additional filing or application processing fees required under 37 C.F.R. §1.16 or 1.17, or to credit any overpayment, to Deposit Account No. 04-0100.

Dated: March 9, 2009

Respectfully submitted,

By 71-B 71t, 47,993, for!

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